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Red Belt in Lodgepole Pine in the Front Range of Colorado

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Foliage injury known as red belt appeared in lodgepole pine stands in the Front Range of Colorado in the summer of 1989. One year later, mortality in the red belt trees in one stand was 1%. Ninety-seven percent of the trees put on new growth in 1990. No bark beetle activity was apparent in the red belt trees in 1990.

Keywords: Foliage injury, red belt, lodgepole pine, *Pinus contorta*

Injury to the foliage of lodgepole pine, *Pinus contorta* Dougl. ex Loud., results from several sources, including insects, diseases, fire, and extreme temperatures (Furniss and Carolin 1977). A spectacular but infrequent injury to lodgepole foliage is a condition commonly called "red belt" or winter burn (Fowells 1965). Red belt injury derives its name from the reddish color of the needles on trees that form a belt or band along a particular contour or elevation.

Red belt is caused by the alternate chilling and warming of needles in air of very low moisture content and usually develops in late winter or early spring when the ground is frozen and the trees are dormant (Henson 1952). Chinook winds passing over lower cold air cause rapid warming and drying of the trees at the interface between the cold and warm air (Henson 1952). The affected trees are unable to translocate water from the roots to the needles, and the needles desiccate when warm temperatures cause them to transpire. Because the affected trees were at the interface of the cold and warm air, a band or belt of red trees appears once the desiccated needles turn red.

In summer of 1989, red belt appeared in several locations along Colorado Highway 72 in the Front Range of Colorado. The condition apparently resulted from extreme temperature changes in late January and February. On February 1, the high temperature in Estes Park was near 51°F. On February 4, the high temperature was near 10°F. One day later, the high temperature was 12°F and the low −34°F. This temperature change was caused by the "Alaska Blaster," a large mass of cold air that plunged southward from Alaska and arrived in Colorado on February 1. Prior to the arrival of the cold air, temperatures were near record at lower elevations in eastern Colorado (NOAA 1989). Chinook winds or warm downslope winds after the cold spell are not evident in NOAA (1989) records, but nighttime lows above freezing in Estes Park on February 8–10 and 18–20 are indicative of chinook winds (Nolan Doesken 1990, personal communication).

This note reports on the red belt condition in one lodgepole pine stand. More specifically, it reports on subsequent tree mortality, foliage loss, and insect infestation of the affected trees.

Methods

Red belt trees appeared in several locations along Colorado Highway 72 between Ward and Nederland in 1989. In September 1989, 100 red belt lodgepole at one location 1.2 miles south of Ward were examined with regard to condition (alive or dead), the presence or absence of bark beetles, and the percentage and distribution of reddish foliage throughout the crown. During examination, each tree was measured diametrically and tagged with metal tags. Tree diameters ranged from 3.9 to 10.5 inches. Although stand density was not precisely determined, the stand was considered heavily stocked and dense. Some trees had one-sided crowns, while more open-grown trees had more symmetrical crowns.

In September 1990, the trees were reexamined with respect to their condition (alive or dead), foliage loss, and the presence or absence of bark beetles. The data were summarized and percentages computed from the summaries. No statistical tests were performed.

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Results and Discussion

Nineteen months after the red belt condition was triggered, 99% of the affected trees were still alive. Only one tree had died from unknown causes. None of the trees were as yet attacked by the mountain pine beetle, *Dendroctonus ponderosae* Hopkins, or other scolytids.

During examination in September 1989, crown coloration varied from essentially all red, to predominantly red with tufts of new growth, to completely red in the upper third with the lower two-thirds green, or to completely red on one side and mostly green on the other sides. About 90% of the affected trees had predominantly red crowns with a small amount of green new growth at the ends of the branches. Eleven percent had essentially all red crowns or red foliage only in the upper third of the crown. The dense nature of the stand caused many of the trees to have one-sided crowns and resulted in reddish foliage on only that side. However, trees with full symmetrical crowns had the discolored foliage mostly on the east side.

Although we did not quantify the amount of new growth on the red belt trees in 1989, we observed it on most trees. In 1990, new growth was present in varying degrees on 97% of the trees. Within the 97 trees with new growth, 80 of the trees had new growth on all aspects and levels of the crown, while 17 had the new growth present in the lower one-half to two-thirds of the crown or on some branches but not uniformly on all branches. The upper crowns on the 17 trees were essentially dead.

Winter damage in our stand was not as severe as that caused by the same weather conditions in Montana stands. New growth in five Montana stands was present on 18% to 88% of the affected trees (Klein 1990), while 97% of our trees had some new growth. Thirty-three percent of the affected trees lost 50% or more of their crowns in Montana stands (Klein 1990), while 17% of our affected trees lost about 33% to 50% of their crowns. The extremely low temperatures appeared to be sustained longer in Montana than in Colorado, which may account for the difference in damage.

The red belt trees were readily distinguishable from the highway in September 1989. One year later, the trees were barely distinguishable because of the loss of the reddish foliage and the new growth at the branch tips. The remaining red needles were sufficiently camouflaged by the new growth.

To date, the red belt condition has not led to an increase in bark beetle activity or significant tree mortality. We expect the condition to be invisible by the fall of 1991, two growing seasons after the red belt condition appeared.

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